Miami Physics Conference 2024

Date: Dec 12-19, 2024

Location: Lago Mar Resort

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Cosmology of the Higgs Effective Field Theory

Abstract

Effective Field Theories (EFTs) are a model-independent framework which can be used to classify the low-energy effects of heavy, new physics on experimental results which deviate from the Standard Model prediction: new, heavy particle signatures could show up at particle colliders as small effective coupling modifications, rather than distinct resonances. For this reason, the Standard Model Effective Field Theory (SMEFT), where the Higgs doublet transforms linearly under electroweak symmetry, has gained recent popularity. However, the SMEFT is not as general an EFT as the Higgs EFT (HEFT), where the Higgs doublet transforms non-linearly. But is it SMEFT or HEFT/SMEFT? Particle colliders will certainly shed some light on this dichotomy, yet they can only probe near our vacuum. We turn instead to cosmology and to the gravitational waves that may have been produced in an early universe first-order phase transition from a false vacuum. This transition could be sensitive to extended field configurations, which in turn could provide us with a new approach from which to probe the SMEFT or HEFT/SMEFT dichotomy, and the nature of electroweak symmetry breaking.